



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER OF PATENTS AND TRADEMARKS  
Washington, D.C. 20231  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/285,986	04/05/1999	SHIH-SHIUNG CHEU	TSMC98-403	4368

7590

02/27/2002

STEPHEN B ACKERMAN  
20 MCINTOSH DRIVE  
POUGHKEEPSIE, NY 12603

EXAMINER

BEREZNY, NEMA O

ART UNIT

PAPER NUMBER

2813

DATE MAILED: 02/27/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/285,986

Applicant(s)

CHEU ET AL.

Examiner

Nema O Berezny

Art Unit

2813

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 31 October 2001.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-25 and 27-30 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-25 and 27-30 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 05 April 1999 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

## **DETAILED ACTION**

### ***Continued Examination Under 37 CFR 1.114***

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 10-31-01 has been entered.

### ***Claim Rejections - 35 USC § 112***

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 1-25 and 27-30 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The following items contain issues of new matter.

a) Claims 1, 15-18, and 20 claim in part that interconnecting lines or wiring layers are adjacent to the bond pad(s). There is no disclosure of this in instant specification, including amendments to said specification.

b) Claims 1, 8, 15-18, and 20 claim in part the interconnecting lines have ultra-small line spacing technologies. There is no disclosure of any line spacing dimensions in instant specification, especially disclosure of ultra-small line spacing dimensions.

c) Claims 1, 8, and 20 claim in part, filling keyholes with photosensitive polyimide between closely spaced interconnect lines will eliminate any detrimental effect caused by accumulation of semiconductor material inside said keyholes. Instant specification discloses on p.20 certain advantages of polyimides, such as filling small openings without producing voids and the ability to withstand high temperatures without dielectric breakdown. However, this is not an all inclusive list of any and all detrimental effects that could result.

d) Claims 1, 8, and 20 claim in part, filling keyholes with photosensitive polyimide between closely spaced interconnect lines will eliminate the negative effect that passivation layer imperfections have on device reliability. There is no disclosure of eliminating any or all of the negative effects of said passivation layer on device reliability.

Claims 1-25 and 27-30 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Claims 1, 8, and 20 claim in part that, filling keyholes with photosensitive polyimide between closely spaced interconnect lines

Art Unit: 2813

will eliminate any detrimental effect caused by accumulation of semiconductor material inside said keyholes. Instant specification, and all amendments thereto do not disclose to one of ordinary skill in the semiconductor art how to apply said polyimide in such a way as to eliminate any and all detrimental effects that could result from the accumulation of semiconductor material inside said keyholes.

Claims 1-25 and 27-30 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Claims 1, 8, and 20 claim in part that, filling keyholes with photosensitive polyimide between closely spaced interconnect lines will eliminate the negative effect that passivation layer imperfections have on device reliability. Instant specification, and all amendments thereto do not disclose to one of ordinary skill in the semiconductor art how to apply said polyimide in such a way as to eliminate any and all negative effects due to passivation layer imperfections.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-25 and 27-30 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claims 1, 8, 15-18, and 20 claim in part that, the interconnect lines or wiring layers are adjacent to the bond pad(s). Webster defines

"adjacent" as objects that are directly contacting one another, or as one object that is not far from the other object. Since there is no disclosure in instant specification for said claim in part (see rejection above), it is unclear what is being claimed in said part.

Claims 1-25 and 27-30 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claims 1, 8, 15-18, and 20 claim in part that, the interconnect lines or wiring layers have ultra-small line spacing technologies. Since there is no disclosure in instant specification for said claim in part (see rejection above), it is unclear what is defined as ultra-small.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-25 and 27-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dass et al. (6,143,668) in view of Fu et al. (5,807,787). Dass discloses providing top level interconnecting lines (col.1 lines 26-29) and top level bond pads (Fig.5 el.55) comprising aluminum and aluminum/copper alloy (col.2 lines 42-46), formed on a semiconductor substrate comprising circuit elements therein (col.1 lines 26-33); depositing a passivation layer of silicon nitride over said interconnect lines and said

Art Unit: 2813

bond pads (el.60; col.2 lines 46-48); depositing a photosensitive polyimide layer (el.65) over said passivation layer; patterning and etching said polyimide layer above said bond pads (Fig.6); then patterning and etching said passivation layer above said bond pads using He/NF(3), thereby exposing said bond pads (Fig.7; col.2 lines 61-62); then curing and cross-linking said polyimide layer (col.2 lines 63-65), wherein said patterned and etched polyimide is not removed (Fig.8; col.2 lines 63-65). However, Dass does not disclose forming an insulating layer over the main semiconductor substrate surface, or depositing two passivation layers, or forming interconnect lines comprising aluminum or aluminum/copper, or forming a bond pad thickness of 4000 – 8000 Angstroms, or forming a polyimide thickness of 5.0 – 9.5 microns, or specific claimed deposition, etching, and curing parameters.

Fu discloses a method of forming bonding pads, comprising: forming an insulating film of silicon oxide over the semiconductor substrate main surface (col.4 lines 8-28); depositing two passivation layers using PECVD at a temperature between 350 and 450 degrees C (col.5 lines 18-21), comprising a plasma enhanced oxide layer and a plasma enhanced silicon nitride layer (col.5 lines 14-18) over said insulation layer and over said interconnects and bond pads (col.5 lines 25-26), which comprise aluminum and aluminum/copper alloy (col.4 lines 11-12); and depositing a photosensitive polyimide layer (col.5 lines 37-40) at a thickness of 5.0 – 9.5 microns (col.5 lines 47-49). The two said passivation layers have a thickness of 7000 – 12,000 Angstroms; the oxide passivation layer uses Ar/CF(4) as an etchant (col.5 lines 27-30); the bond pad thickness is 4000 – 8000 Angstroms (col.5 lines 8-9); the polyimide is

Art Unit: 2813

patterned and etched by cross-linking with ultra-violet radiation through a mask, and the non-cross-linked polyimide is dissolved away in a solvent over the bond pads (claim 8); and the polyimide is cured in a nitrogen ambient at a temperature of 300 – 400 degrees C for 1.5 – 2.5 hours (claim 9).

Therefore, it would have been obvious to a person skilled in the art at the time of the invention to use the method of Fu with the method of Dass for forming bonding pads. The two passivation layers of Fu offer the benefits of both an oxide layer, which can relieve stress and therefore avoid cracking, and a nitride layer, which has better moisture resistance than silicon dioxide (Microelectronics Packaging Handbook II, p.477-478). The claimed layer thicknesses and formation parameters are commonly fabricated and practiced within the semiconductor industry in order to produce optimum operating results of a semiconductor device. Both Dass and Fu are fabricating bonding pads and a method of improving the performance of said pads, and therefore, Dass would have used most or all of the fabrication and operating parameters of Fu.

Dass and Fu do not disclose depositing the first passivation layer at a pressure of 2.0 – 2.8 Torr for 8 – 12 seconds, and the second passivation layer at a pressure of 4.0 – 5.0 Torr for 50 – 60 seconds; or etching the first passivation layer at a pressure of .30 – .40 Torr for 33 – 39 seconds, and the second passivation layer at a pressure of 1.2 – 1.3 Torr for 20 – 30 seconds. The specification contains no disclosure of either the critical nature of the claimed operating parameters or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen



dimensions are critical. In re Woodruff, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

### ***Response to Arguments***

Applicant's arguments filed 10-31-01 have been fully considered but they are not persuasive. Applicant contends on p.10 and p.14 that Dass does not disclose metal interconnect lines and a bond pad over a semiconductor surface. This argument was already addressed in the last Office Action on p.5 item 1).

Applicant contends on p.11 that Dass does not provide for a thick layer of polyimide overlying the interconnect traces. This argument was already addressed in the last Office Action on p.5 item 2).

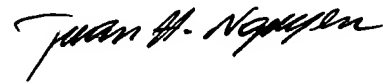
### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nema O Berezny whose telephone number is (703) 305-3445. The examiner can normally be reached on M-F 8:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on (703) 306-2794. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7722 for After Final communications.

Art Unit: 2813

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.



Tuan H. Nguyen  
Primary Examiner

NB  
February 19, 2002